TECHNICAL ENTREPRENEURSHIP IN THE LARGE FIRM:
A STUDY OF BARRIERS AND FACILITATORS

by

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ABSTRACT

This is a report on a study of the conditions encountered in attempts to initiate and effectively conduct technical venture/entrepreneurial (V/E) projects in a large company environment. The study involved a large data base of propositions related to the V/E process in the firm. This "propositional inventory" is derived from several dozen actual cases of attempts, successful and unsuccessful, to carry out V/E projects in this large sample of industrial firms, as well as the growing literature on this subject. The propositional inventory is being prepared in a format that will make it possible to query it in an interactive mode with such questions as: "What factors keep a V/E project from getting beyond the early 'talking' or 'idea' stages?" and "What factors (barriers and facilitators) influence the likelihood that such a project will survive the phasing back into an operating division for full-scale commercialization?"

The paper describes the methodology of extracting propositions from the raw data-narrative case studies and the literature. A sample of the propositional inventory is included. A stage model is also presented, adapted from previous research on R&D/Innovation in organizations by the authors and other researchers. The model includes the following milestones: The idea stage—involving the "notion" and "formal proposal" sub-stages; Initiation of a V/E project; Establishment of technical feasibility; Technical maturity; Market or plant introduction; and acknowledged commercial success. At each of these milestones, the V/E idea or project may die, be stalled, be recycled, proceed to the next downstream stage in its life cycle, or leapfrog into a succeeding stage further downstream.

NOTE: An earlier version of this paper was presented at the Second International Conference on Engineering Management, Toronto, Canada, September 1989, and was co-authored by Albert H. Rubenstein, Eliezer Geisler, and Peter Lai.
1. Objective and Motivation for the Study

The objective of the research described has been to begin a systemization of the literature and experience on technical entrepreneurship and venture management in the large firm. This is expected to provide more effective guidance to organizations and individuals engaging in, supporting, and managing such projects than is available from their own direct experiences and the anecdotal and casually-observed experience of others.

Three factors converged to make the undertaking of this research appropriate at this time: a) The first was the increasing interest by a number of large industrial companies and some smaller ones in alternative routes to developing and commercializing significant and urgent new products and technologies—alternative to the formal structures and functions which are responsible traditionally for developing and introducing new and improved products and processes. Experience with such nontraditional means such as internal venturing or technical entrepreneurship involving significant new products and fields of technology has been mixed, at best.

Several major firms have cut back on or eliminated such efforts and reverted to former, more routine methods of handling such projects and/or have gone increasingly to outside sources and modes, such as: acquisitions, licensing, joint ventures, strategic alliances, limited partnerships, minority investments, direct purchase, and/or contracting out for technology.

There have been enough successful cases, however, in addition to the unsuccessful or marginal ones, to suggest there might be some underlying patterns at work, influencing the success/failure ratio and the outcomes of individual projects. Among these patterns are certain recurring barriers to progress and success, facilitators to progress and success, and conditions in the internal and external environments of the firm whose identification increases our understanding of the V/E process and specific conditions which can significantly influence the outcomes. There is little hope for a "one factor" explanation of success/failure, but it is likely that ultimate theories and models will contain a limited set of major explanatory factors. That is, despite the apparently unique characteristics of each individual V/E project in each firm and each period of time, a major part of the variation in progress or outcome is potentially explainable via a small set of "necessary and/or sufficient" conditions for progress, success, or failure.

b) The authors and their colleagues have been exploring this non-conventional mode of technical innovation in the firm for several years as spin-offs from various research studies, including: Idea Flow, Project Selection, "Make or Buy" of Technology, Impacts of Decentralization on R&D/Innovation, R&D-Production Interface, Industry-University Relations, The Software Development Process, Technology Transfer, Strategic Technology Planning, Innovation in Small vs. Large Companies, and others.
2. **Methodology**

The procedure for Phase I of the study was composed of the following stages, some of which were undertaken in parallel or in an overlapping mode:

A. Content analysis of the data we have collected on factors relating to the Venture/Entrepreneurship (V/E) process in large firms.

B. Continuing literature analysis to augment the existing data set.

C. Case studies on successes and failures of V/E projects in large firms.

D. Development of a set of categories and operational descriptions of barriers and facilitators to the V/E process.

To accomplish the above, the study was undertaken in four parts: 1) we surveyed the current literature on technical entrepreneurship and on entrepreneurship in general. The literature surveyed included the academic/research literature as well as trade magazines and books.

2) We compiled a set of cases of technical entrepreneurship from the literature surveyed and cases presented by guest speakers presented in a graduate course on technical entrepreneurship. In addition cases were prepared by graduate students in the seminar who are experienced managers in large companies in the Chicago area.

3) We analyzed the data collected, adding as input to our analysis the experience of the members of our team, who collectively have over 50 years of experience in the management and the study of technical entrepreneurship. The content analysis of the data gathered was then placed into a "proposition inventory" which identified, in a potentially testable form, factors influencing success and failure of V/E projects. In addition, the analysis yielded a set of categories and operational descriptions of barriers and facilitators to the V/E process, in a form which would potentially permit limited measurement via scales, category sets, and ranking of importance and frequency.

4) For lack of a useful structural model of the technical entrepreneurship process in the literature we reviewed, we developed a stage model of the process. The model identifies various stages in the development of the technical V/E project, from the generation of the idea, through the pre-proposal and proposal stages, to the downstream stages of review and implementation to (potential) commercialization. The model is shown in Section 5.

We identified three major phases in the model, which describes how a technical idea for a V/E project emerges and is developed within the large firm. For each of the phases we have identified propositions which describe the conditions influencing and the outcomes of specific stages in that phase. Overall, we identified 198 propositions for all three phases. These constitute our current proposition inventory for the phenomenon of technical entrepreneurship in the large firm. Examples of these propositions are given in Section 7.

The phases and the specific stages they contain provide categories which can help characterize the entrepreneurship process. By placing the propositions we extracted from the literature, the cases and our experience, into these categories, we have initiated an attempt to design an interactive knowledge-based, computerized system. Initial ideas on such a system are described in Section 4.
3. Findings from Phase One of The Study

Four major findings emerged from Phase One of this study.

First, there seems to be some convergence in the propositions and "rules of thumb" in both the literature and the experience of managers, on how to organize and manage technical entrepreneurship in the large firm. For example, it is widely accepted that a champion is needed for an idea to proceed through the various stages of the flow and development of a V/E project. The champion is crucial in the early stages of the flow. It is also widely believed that the more detailed and "business" oriented the V/E idea, from its early stages of development within the large firm, the better chance it has to succeed.

Much of the convergence can be tentatively explained in general terms about the phenomenon itself, namely: the large company setting; the effects of politics, finance, and bureaucracy in the large firm; the personality types of people who push new ideas; the nature of the review and implementation processes for new ideas; the power position of the various levels of management involved in the project; and the gaps between the technical side of the firm and its strategic/business aspects.

These convergences strengthen our belief that there are generalizable barriers, constraints, and process stages in the complex phenomenon of technical entrepreneurship. The convergences also lead us to believe that there can be some methodological approaches and methods of organizing and managing, which may not eliminate all uncertainty and failures, but which can help reduce the number of failures, and also reduce the uncertainties and the strain on the entrepreneur, his colleagues, and the organization.

Second, we found much divergence in propositions and practical "rules of thumb" held by managers on many aspects and issues of V/E in the large firm. For example, the literature tends to argue that an important facilitator in developing V/E ideas and projects is the overall recognition in the large firm that innovation is a positive factor in the company's competitive stance and that the company needs some crucial and "breakthrough" innovations. Although managers, particularly top managers, would tend to generally agree with this statement, they differ in their approach, perceptions, and tactics in evaluation, funding and other support of "radical" V/E projects.

Some of the divergence can be explained generally by differences in the organizational culture, fields of technology, circumstances peculiar to specific ventures at particular times, the general approach to innovation in the firm, and the "fit" of the V/E ideas and projects with the firm's goals and strategic business and technology objectives at a given time.

Although there are many attributes and aspects in the V/E process which are specific to each large firm and even to particular V/E projects, there are, nevertheless, some general patterns which can be captured and developed into credible guidelines for improving the conduct and management of V/E projects.

Third, many of the critical factors which impinge on the downstream success or failure of V/E ideas and projects are organizational and behavioral in nature. Key technical and, to some degree, economic feasibility issues are often handled inadequately in the early review stages. For example, the perceptions by the entrepreneurship and his colleagues of such factors as: corporate rules and constraints, individual and corporate rewards, the goals and needs of the firm, and the support top management gives to an idea or a line of business or a technology area, are crucial factors in the success or failure of a V/E idea or project.
Other examples are factors which we have identified as "fatal flaws" in the various stages of our conceptual model shown in Section 5. These can be critical failure-inducing or failure-influencing factors, such as:

a. The inability of evaluators, including the idea's champion and his superior, to agree on the methods and criteria for evaluating an idea. The lack of agreement may be due to the lack of a corporate policy in this regard, little previous experience with entrepreneurs, different perceptions on the limitations on resources for new activities in the various units of the firm, and differences in the way individual evaluators perceive the "fit" between the idea and the firm's objectives and "mainstream" activities.

b. The tendency, in many firms, to underestimate the burdens, tasks, and the pitfalls of implementation and commercialization of a V/E project. Many times an idea and a project may be reviewed and subsequently approved with little or no plan, including contingencies, for a long and difficult process of implementation and commercialization.

c. Resistance on the part of other managers in the firm may be fatal to an idea or a project. Even when the idea is presented as a potential project with its separate organizational structure and locus of operation, existing managers of different units may resent the separation and perceive the project as a potential threat to their authority, budgetary resources, prestige, autonomy and the status quo.

Conversely, there are critical factors which can facilitate the development and the success of a V/E idea and project. Some examples are:

a) Active support from a champion and his/her superior is crucial to the successful development and survival of the idea and the project. The higher the level of support, the more likely the idea/project is to survive into succeeding stages and phases of the process. The minimum required for the survival of the idea and the project is having the "superior" not oppose the idea/project.

b) Existence of "slack resources" in the firm, primarily when these resources originated or are attributable to commercial successes of previous VIE projects and new products. Thus, a firm which has had commercial success with VIE products and accumulated slack is more likely to support other VE projects. A "cash cow" company or operating division which owes its success to an established product line will be less likely to actively invest in VIE projects.

c) Existence of technically trained or technically minded/oriented managers at the high echelons of the firm, outside R&D. At the very least, there should be little or no technology "phobia" on the part of top management.

Fourth, the incentives/rewards for entrepreneurs proposed in the literature and those already practiced by managers tend to: a) converge to some degree; b) be implementable without much expense or radical organizational changes, and c) yield some powerful behavioral results and benefits.

For example, an accepted incentive is the reduction in the potential entrepreneur's routine work requirements and time pressures, thus freeing him/her to engage in more creative and innovative activities. There is clearly no guarantee that such an incentive will produce the expected benefits, but the literature has long argued, and the experience of many firms demonstrates, that when such an incentive is applied, chances are good that a potential entrepreneur will devote a disproportionately larger effort to creative or entrepreneurial activities.
Rewarding the entrepreneur by means of financial incentives and participation in the fruits of a commercialized invention is another acceptable strategy. Such rewards may require changes in the firm's policies of compensation while acting, in parallel, to reduce the resentment of other employees.

Finally, incentives may include the strengthening of the entrepreneur's and the V/E process' prestige and status in the company, by publicizing: V/E efforts and outcomes; V/E benefits to the firm; awards and honors, and the establishment of well-publicized, less bureaucratic formal processes for the generation, evaluation, funding and implementation of V/E ideas and projects.

These initial findings suggest that the existence of generalized patterns of the V/E process and the possible critical influence of selected factors (which can be manipulated by management) on the success or failure of V/E ideas and projects—represent strong arguments in support of the idea that management can act to strengthen the technical entrepreneurship process in large firms, and to monitor and control some of its critical barriers and facilitators.

The findings also suggest that the analysis of the process and consequent managerial interventions should take into account the phase and stage of the development of an idea/project, the general patterns of behavior related to the idea/project, and the specific attributes of the individual company and its human resources which provide the environment for V/E projects.

4. Some Implications for Management

(1) At certain phases it is potentially beneficial for specific members of top management and/or middle/divisional management in the large firm to intervene in the V/E process and to affect changes which may strengthen and improve the rate of success of V/E ideas and projects.

(2) Some organizational and behavioral factors, such as the setting up of an evaluation and review process for V/E ideas and projects and an incentives/rewards system for entrepreneurs, can be implemented with relatively few resources and little organizational change on disruption.

(3) Most large firms seem to have some potential technical entrepreneurship talent in its personnel. Management's role is to uncover, nurture, and guide such talent in their pursuit of V/E ideas and projects.

(4) Many of the critical and "fatal" barriers to the survival and the successful development of V/E ideas and projects have been identified in our data base and propositional inventory, based on the literature and experiences of practicing managers. Managers concerned with the V/E process in their firms can benefit from this existing body of knowledge in planning, designing, operating, monitoring and evaluating them.

(5) Although the phenomenon of technical entrepreneurship in the large firm is a complex and multifaceted phenomenon, it nevertheless lends itself to analysis and to categorization into dominant or frequent patterns of behavior and convergence of specific cases into generalized trends.

(6) V/E ideas and projects which are nurtured in terms of an adequate champion, support from top management, a structured evaluation process, an organizational culture which
favors and encourages innovation, an adequate system of incentives and rewards for entrepreneurs, and resources allocated to the funding and implementation of the V/E ideas and projects are likely to have a higher than usual success and ultimate commercialization rate as new or improved products, processes, and services.

(7) Managers at all levels of the large firm should not be passive observers of the V/E process. They should rather be actively involved in affecting the barriers to V/E activities (by reducing or neutralizing them) and in encouraging and/or reinforcing the facilitators to the V/E process.

(8) Technical entrepreneurship is as important to the marketing/strategic management of the large firm as the firm's management wants it to be. The perceived "gaps" between the technical side of the firm and its strategic management are not insurmountable and can be bridged by careful, informed intervention with respect to the critical factors (barriers and facilitators) which impinge on the V/E process.

(9) Technical entrepreneurs are an invaluable resource to the large firm. They are an already existing resource (at least temporarily), proprietary to the firm, with vast potential to create and innovate, under beneficial conditions and in a supportive environment. The large firm's management has the opportunity and the responsibility, to create and to maintain such a supportive environment.

(10) Infant projects should be nurtured by the large firm, and a suitable organizational and geographic location in the firm should be found for them. Organizational, personality, political and other factors should be taken into account when deciding on a "home" for such projects. The dichotomy between establishing the V/E project within the R&D unit or outside it as an independent entity, or in an operating unit, has been handled by many organizations by opting to locate the V/E project under the control of a commercial unit or a new or special Strategic Business Unit (SBU). Management should be aware of potential problems of lack of communication, availability or lack of technical assistance, and a commercial-like climate which may be too constraining in the early upstream stages. Although there are no clear and tested solutions yet, top management should consider the specific circumstances of its own firm and the many factors listed above, before deciding on a "home" for such V/E projects, since such a decision may strongly influence the death or survival of such projects.


Figure 1 presents a conceptual flow model, derived from previous research by the Northwestern group and others, on idea flow and entrepreneurship. Phases I and II in this model emphasize the early, upstream phases of the overall technical entrepreneurship process - namely the idea generating, communicating, evaluating, and decision-making aspects of getting a new V/E project launched. Phase III covers, very briefly, the actual conduct of the project or venture in terms of monitoring, reviews, and its outcomes - commercialization, recycling, or terminating. Our emphasis on the upstream phases reflects our belief that it is in these early stages that critical decisions affecting the likelihood of success of the V/E project are made and that potentially "fatal flaws" and insurmountable barriers are frequently ignored or allowed to become part of the environment for the project.

6. Initial Ideas on an Interactive Knowledge-Based System for Use by Managers

One objective of the longer-term study (beyond the phase one reported in this paper) is to develop and test a knowledge-based system containing the propositions and other information about barriers, facilitators and fatal flaws which could be of assistance to researchers in this field and to managers and entrepreneurs
considering initiating, conducting, or managing V/E projects within their firms. Several probes were started in the early stages of the project in the direction of either developing or adapting a software package or expert system shell to this purpose. Several interesting possibilities exist and in later phases of the overall research on this topic, we hope to further explore this avenue. For the present, we have outlined some of the features of such a system below:

FIGURE 1: A CONCEPTUAL MODEL OF THE IDEA PHASES OF TECHNICAL ENTREPRENEURSHIP

PHASE I: GENERATION AND PROPOSAL OF IDEAS
New venture/ enterprise (business unit or "spin-off" in venture) This is a composite of several models suggested by Rubenstein, Geisler, Baker, Pound, Glaser and Burch. Not all stages occur for all ideas, and not all stages occur in the same sequence, although a formal procedure would tend to maintain an established sequence. ** Decision point.
I. USER:
   A. Researcher (means of recording observations, empirical findings, anomalies, a priori assumptions based in theory).
   B. Manager in the firm. Using the data base for decision making and for learning about the experiences of others.

II. SOURCES OF INFORMATION FOR THE DATA BASE:
   A. Cases
   B. Literature
   C. Experiences of managers and researchers

III. FEATURES:
   A. Presentation of data in matrices with potential for multidimensional analysis.
   B. Graphic options to demonstrate relationships between factors.
   C. Ability to play "what if" and allow for searches of the data base by key words.
   D. Interactive mode to meet users' needs.
   E. Friendly enough to allow wide usage by managers and researchers.

The interactive system allows for the extraction of parts of a proposition, namely the dependent or the independent variables. It also allows for comparison across propositions to identify the number of times a certain variable appears in the data base, as well as other manipulations.

7. A Sample of Propositions from the Inventory

Several hundred propositional statements have been abstracted, to date, from the various sources mentioned earlier - the literature, the case studies presented by guest speakers in our seminars on Technical Entrepreneurship, student projects, and the direct experience of members of the research team and others engaged in the process within the large firm. In this section, we present a sample of 14 of those propositions.

NOTE: At this early stage of collecting actual cases studied as raw material for the proposition inventory, many of the propositional statements below may be considered tentative in the sense that they reflect a very limited data base of actual experiences with respect to outcomes, e.g., successes and failures of V/E projects in large firms. Many of these statements are also fed by "convergent informed opinions" of people experienced in this field (e.g., through the literature and the direct experience of the research team members). Therefore, some of the propositions below containing apparent "probability" statements are not based on adequate data of empirical frequencies - i.e. the number of actual successes and failures. They are, indeed, propositions or potentially testable hypotheses, formulated from the available knowledge from all the sources we used and our "best guesses", based on such sources. As the proposition inventory is fed with more actual cases and the wording is refined in future stages of the research, dependent variables such as "probability of success" will either be based on a more substantial data base or be rephrased into "softer" predictions, such as "are likely to proceed to the next phase" or "are likely to continue to be supported by management".

P1 — If the entrepreneur has perceived technical credibility in the company, then his idea is more likely to be compared favorably with other ideas in the company's pool of ideas.

P2 — If the idea has a potential market/use as perceived by colleagues in the firm, then the idea will compare more favorably with other ideas, past and present, in the company's pool of ideas.
P3 — If the idea is presented with commercial applications and/or potential commercial benefits—even at an early stage and even in quite speculative form—the idea is more likely to develop into a product.

P4 — If the technology utilized or advocated by the V/E project team matches the firm's areas of technological capability or planned areas of technological thrusts, then the V/E project is more likely to succeed.

P5 — If the entrepreneur does not have support from his superior and his superior's manager, and if such support is not perceived by the people he interacts with on the project, then the new venture is likely to fail, often at the idea stage.

P6 — If the entrepreneur, who is good at inventing and doing the technical work, yet a weak businessman and manager, does not know when to stop and convinces his management to allow him to manage the downstream phases of the new venture, then the venture will have a high probability of failing.

P7 — If top management in the large firm supports internal venturing primarily by focusing on individual entrepreneurs, at the expense of developing other technical and managerial skills and resources to manage all phases of the venture, then the new venture will have a high probability of failing.

P8 — If an internal venture group is working in isolation on product ideas that constitute a new business, in an incubator-like environment which does not incorporate key factors in independent start-up companies, the likelihood of failure is high.

P9 — If, in the large firm, over a five year period, there have been no entrepreneurial employees who left to start-up their own businesses, then the firm may not be providing an atmosphere conducive to entrepreneurship, or may be doing a great job of "growing" and keeping entrepreneurs.

PIO — If a new venture team is overly pampered by the corporation, to the extent that its members are not forced nor trained to make focused, market-oriented decisions, which may mean life or death to the venture, then the team will most likely lose its sense of urgency, leading to the long term failure of the venture and the team itself.

P 11 — If the corporation over-controls or under-controls a new venture project, rather than achieve a balanced amount of control, adapted to the special circumstances of that particular venture, then the new venture will have a high probability of failing.

P 12 — If "normal" misunderstandings, conflicts, rivalry, and other emotional manifestations of the relations between the new venture team and other operations and functional people in the company do not exist or are not acknowledged and dealt with, then the new venture has a low probability of succeeding.

P 13 — If the new venture team does not employ the help and advice of external scientific and technical sources when it encounters technical problems it cannot effectively handle and adopts the attitude of "not invented here", and if it is supported by management in such an attitude, then the new venture will have a high probability of failing.
P 14 — If the large firm does not possess a "knowledge base" of "failed" new ventures at different stages of development (ideas, projects, prototypes) and if such a knowledge base, including the factors contributing to prior failures is not used as a learning tool for new venture teams, then subsequent new ventures will have a high probability of failing.